behavior, which considered as brittle structures. Therefore, this paper focuses on contemplating nonlinear behavior with flexible members with limitation states on damage states that are not considered in former studies. In order to investigate the efficiency of negative stiffness device on seismic performance of two moment-resisting frames, 5- and 8- story structures with nonlinear behavior on frame elements with the distribution of NSD within the several floors have been considered as the case study configuration in this study. Therefore, incremental dynamic analysis is conducted to identify the effect of NSD system on nonlinear behavior and collapse levels of structural models according to FEMA p_695 approach. The results presented in this paper demonstrate that by placing an NSD within several floors, the structure above that story undergoes less deformation and, consequently, will be reduced to be suffering from the effects of ground motion.

Key Words: Negative stiffness device (NSD), incremental dynamic analysis (IDA), fragility curve, nonlinear behavior.

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Abstract

Complexity forces in deep foundations, such as piles and micro-piles to dynamic analysis, are most important parts of analyzing. Low effect seismic destruction is considered to run this type of foundations. In the present article, Micro-piles modeling have been investigated for double groups by applying different angles, including 15^0, 20^0, 25^0, 30^0, 90^0 using ABAQUS software. Soil environment has been modeled in both Single-layer and that which is layered with consider making two types of elastic and plastic behaviors with Drucker-Prager model. In both cases, is investigated the effects of soil with soil and micro-pile interaction have been investigated, on micro-piles behavior. Dynamic analysis was carried out with the vertical load to cap the micro-piles and by entering acceleration onto the model floor with assuming linear attenuation by El-Centro earthquake record and sinusoidal harmonic acceleration. At the end, evaluation of these changes in stress distribution in the soil, the relative displacement, change of bending moments, and axial forces for homogeneous and non-homogeneous soils has been carried out. Dynamic analyses have shown that angel of micro-piles from vertical to25Ŏ2da is the cause of the reduction of the stress level in the soil. The maximum bending moments and axial forces occur near the cap of the micro-pile and continue the depth of micro-piles; this change is minimal. This subject states proposes micro-pile importance in reducing displacement, especially in cases of the soil with layers. Due to damping within the upper layers of soil and micro-pile's cap, soil stress distribution has increased; moreover, due to the effect of gravity in more depth of micro- pile, tensions have been reduced in the surrounding soil.

In homogeneous soil, 20- degree angle is suitable for micro-pile angle and the angle of the non-homogeneous soil is 15 degrees for a better distribution of stress. Comparing the relative displacement values and uplift values of homogeneous and heterogeneous soils surrounding the micro-pile 20- degree angle to the right angle is placed in the soil.

Key Words: Dynamic analysis, micro-pile, single-layer and layered soil, layers of soil dynamic interaction.

SEISMIC BEHAVIOR OF STRUCTURES BY ENGAGING ADAPTIVE PASSIVE NEGATIVE STIFFNESS DEVICE SEISMIC NONLINEAR BEHAVIOR EFFECT

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Abstract

Despite the progress in advancing the field of structural control, there is still a vital need to develop new devices to overcome the limitations of the existing approaches to avoiding damages and carrying out attempts to both structural systems and bridge models. Negative Stiffness Device (NSD) is an adaptive system that is purely mechanical and induces negative stiffness behavior in structural systems and bridge models with a pre-compressed spring that pushes the structure away from its equilibrium position. This device produces negative stiffness in a completely in passive manner via a mechanical mechanism without any external power resources for measuring feedback of response of structures with signals of excitation. By engaging the negative stiffness device, composite structure behaves like a yielding structure. The basic advantage of NSD is to distribution manner of the device in several levels of structures or applying it only in ground level of the structures. This novel device resulted in the applicable weakening and softening concept without any weakening and disconnecting frames, and joints and walls in structures so as to decrease lateral strength and increase displacements, and thus a decrease in base shear and acceleration. Studies in negative stiffness device have been limited to specific experimental structure models with linear and limited nonlinear

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Abstract

With proper investigation of project delays, they can be made as lesson learning. So, in this research, a method has been presented to offer network- based pattern for identifying the reasons of delays. For this purpose, reasons of delay in Tehran-Shomal highway are indicated in a table for each group involved in the mentioned project and the main source of delays of the four factors involved in the project: employer, contractor (delay of materials and equipment and human resource, supplier delays, delay in transportation and warehouse that is the prerogative of contractor), consultant, and external factors were identified and categorized. Then, according to the experts' opinions and interviews conducted with agents working in projects, all items of delays have been scored from 0 to 10 since 1994 to 2015 in two cases:, the possibility of delays in the project of Tehran-Shomal and the intensity rate and the impact of delays. In the last section, for the first time, delays in Kohonen self-organizing neural network have been evaluated using MATLAB in the program of SOFM. Delays in research findings that are not distinguished in two ways are not distinct, and overlapp each other.

Key Words: Tehran-Shomal highway delays, Kohonen self-organizing neural network, lesson learning.

SEISMIC BEHAVIOR OF BUCKLING RESTRAINED BRACES WITH STEEL TUBE WITHOUT MORTAR FILLER

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Abstract

One of the methods for stability of structures under seismic loads is the use of steel braces. One of the bracing systems with appropriate performance is Buckling Restrained Braces (BRBs.). This kind of braces does not have weakness such as the conventional concentrated braces under cyclic loading and provides significant capacity of energy dissipation with members restrained from buckling and has symmetrical and stable hysteresis curves.

This system serves as replaceable structural fuses, minimizing the amount of damage to the other members. These studies have been conducted to the restrained buckling braces systems. Most of the cases have been surrounded by the concrete or mortar and the metal sheath. Since the construction of the bracing surrounded with filler material has difficulties, it was necessary to study another type of braces on wich few studies have been conducted. In this research, 11 models of BRB have been studied. selected for the investigation of Buckling Restrained bracing members, including flat plates, cross, double, and circular studs which are without filler, have been surrounded by metal sheath in ABAQUS software. Modeling parameters and lack of enforcement of mortar filler, shape of the core,thickness of sheath are specified by examining the ratio of buckling load of sheath (P_e) to yield load of core (P_y) under cyclic loading. The results have shown that the capacity of energy dissipation of BRB is about 12 times more than the capacity of conventional concentrated braces. The increase of tolerance has been brought about by increasing the ability of the energy dissipation. In addition energy dissipation capability and the maximum capacity of section in the state without filler materials decrease, and the core of circular section is more resistant than the cross and studs sections. Energy dissipation capacity with circular cross-section is compared with the channel and cross section. By increasing the tolerance limit, load model has decreased; however, energy dissipation capability has increased.

Key Words: Buckling braces swing, behavioral curve, capability of energy dissipation, ABAQUS finite element software, Non-Linear cyclic loading.

DYNAMIC RESPONSE OF INCLINED MICRO-PILES IN LAYERED SOILS

the ANN model is more capable with a higher prediction performance compared to the MR model.

Key Words: Artificial neural networks; fuzzy logic; multiple regression; compressive strength.

CEMENT WASTE REDUCTION FRAMEWORK IN TEHRAN'S CONCRETE STRUCTURE RESIDENTIAL BUILDINGS

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Abstract
In sustainable management of solid waste, decreasing construction waste generation is an important step. In developing countries, modern construction techniques are not adopted as in developed countries and contractors follow wasteful manners when utilizing building materials. The result is building material waste which unfavorably affects environment. At the same time, it is considered an earnest concern and a solemn environmental problem all over the world requiring a reliable database to be managed, whereas investigations done by the authors imply that no official organization maintains any related authenticated data, making thriving construction waste management policies too difficult to be defined and implemented in Tehran, Iran.
In this article, variables affecting materials waste were derived from accessible reviewed literature, then using the first questionnaire survey quantities of variables were collected for thirty two representative residential buildings in Tehran. Primary analysis showed that cement is wasted more than other studied materials (about 8.6% by weight). Due to huge amounts of energy and raw materials used in production of cement and pertained destructive effects on environment such as air pollutants emission, cement waste reduction leads to emission abatement and cost saving. This is why cement waste was targeted to be diminished in this paper.
After quantifying cement waste versus dependent variables of this study, it was resulted that "lump sum" contract is preferable to "cost plus" contract in terms of cement waste. Furthermore, designing smaller buildings with more stories is suggested instead of bigger buildings with fewer stories. Since no construction waste reduction policy is implemented in Iran so far, authors conducted a subsequent questionnaire survey to evaluate different waste reduction policies. As a result, defining a financial-based incentive plan ranked the first in order of preference based on opinions of construction experts. Therefore, a financial-based incentive plan was structured. This plan was proven to be both viable economically and justifiable environmentally. These suggestions could be proposed to Tehran municipality to be implementable in sustainable residential building projects.

Key Words: Cement, cement waste management, financial-based incentive, multiple linear regression, Tehran sustainable residential buildings.

PRESENTING KOHONEN NEURAL NETWORK MODEL FOR DETERMINING THE CONTRIBUTION OF EACH FACTOR INVOLVED IN THE DELAYS (CASE STUDY: TEHRAN-SHOMAL HIGHWAY-IRAN)

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Abstract

Recent studies have indicated that moisture environments can weaken the bond between fiber-reinforced polymer (FRP) jackets, epoxy adhesive, and concrete. Nearly in all of past researches, the specimens have been examined under loading and moisture conditions only after strengthening the structural elements, while one of the important applications of FRP jackets is in restoration and reconstruction of the structures subjected to loading and moisture condition. Additionally, there is a high probability that the structural elements are exposed to surface moisture before strengthening in these conditions. The aim of this study is to investigate the flexural behavior of beams reinforced by FRP jackets similar to the real conditions under which the structure is subjected to two essential factors, including moisture and preloading. For this purpose, 20 specimens of concrete beams with dimensions of $150 \times 200 \times 1150$ mm were constructed that falls into two groups with two different arrangements of tensile reinforcement. Other variables were the amount of surface moisture and the level of preloading of specimens. Before strengthening, the specimens were subjected to preloading and moisture conditions, and then ruptured under flexural tests. The results obtained from the tests were the load-midspan displacement curves of the specimen. The results indicated that the flexural strength of the beam with CFRP jackets without cracks and surface moisture increased up to the 20% of its ultimate strength, while, in the beams with premier cracks and surface moisture, only 13% and 9% increases in flexural strength were reported, respectively. Furthermore, in beams with premier cracks and surface moisture, an increase of 13% in ultimate strength was simultaneously seen. The results also suggest that using reinforcing bars with a higher diameter and lower number in comparison to using a lower diameter and higher number of bars could decrease the efficiency of FRP jackets and cause brittle failure in the entire mentioned conditions.

Key Words: Preloading, surface moisture, concrete structures, fiber-reinforce polymer.

PREDICTION OF COMPRESSIVE STRENGTH CONCRETE BY ARTIFICIAL NEURAL NETWORKS, FUZZY LOGIC AND MULTIPLE REGRESSION

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Abstract

In the present paper, artificial neural networks (ANN) and regression analysis for predicting compressive strength of cubes of concrete containing silica fume (SF), fly ash, and Copper slag are developed at the age of 7 and 28 days. For building these models, training and testing using the available experimental results for 66 specimens produced with 6 different mixture proportions are used. The data used in the multi-layer feed forward neural networks models and linear regression model are designed in the format of seven input parameters covering the age of specimen, cement, fine aggregate, coarse aggregate, fly ash, silica fume, and copper slag. According to these input parameters, in the multilayer feed forward neural networks, models are used to predict the compressive strength and durability values of concrete. It was shown that neural networks have high potential for predicting the compressive strength and durability values of the concretes containing silica fume (SF), fly ash and copper slag. Results show that the values obtained from the training and testing in ANN-I (LM Algorithm) model are very closer to the experimental results. The results show that ANN has strong potential as a feasible tool for estimating the ingredients of concrete to meet the design requirements. Also, multiple regression (MR) is a statistical technique that allows us to predict someone's score on one variable on the basis of their scores on several other variables. MR is employed to learn more about the relationship between several independent or predictor variables and a dependent or criterion variable. Therefore, MR analysis was carried out using a MATLAB 2013 package to correlate determined fc value to the seven concrete parameters. The data used while developing the ANN model (i.e., 66 data sets) were used in the development of the MR model. However, the obtained indices make it clear that

cle and their new coordinates. Literature review shows that DEM is a useful tool, particularly in soil mechanics. To predict the shear strength of the soils, the Coulomb theory revised by the effective stress theorem is used, which is suitable for dry or saturated conditions. However, unsaturated condition is the main state of soils in arid or semi-arid regions. From micromechanical point of view, the main difference between the dry or saturated condition and unsaturated condition is in the interparticle force due to menisci formed by pore water and air. In this paper, after formulating the geometry of the menisci and attraction force, they are programmed in a DEM code, PFC2D. The effect of saturation ratio on capillary force and its effect on global behavior of the medium is investigated. The simulations show that attraction forces, due to capillarity, are reflected as the cohesion on macro scale, but the internal friction is not affected by capillary effect.

Key Words: Discrete element method, capillary force, degree of saturation, liquid bridge, shear strength parameter.

AN INVESTIGATION ON OF FOUNDATION INPUT MOTION IMPOSED ON A SURFACE STRIP FOUNDATION CONSIDERING PROXIMITY TO AN EMBEDDED STRIP FOUNDATION

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Abstract

Soil-structure interaction is an emerging issue in seismic design of structures. According to the history of the field, this phenomenon is usually studied in two sequential parts, i.e., kinematic and inertial interactions. Kinematic interaction causes the difference of free field motion and foundation input motion in the absence of masses of super structure and its foundation. Filtering the system input motions is the most crucial characteristic of this part of the problem. In the literature on Kinematic interaction, however, most of researchers have focused on single foundation. In addition, few studies can be found on adjacent foundations with semi-cylinder cross- section under plane SH wave. While every building, located in urban area, is commonly surrounded by various structures. It causes the adjacency of foundations inevitable. Hence, it would be important to investigate the ways to include the effects of nearby foundations on input motions. The existence of neighbor foundations may physically be interpreted as constraints in mathematical equations. In this work, the proximity effect of two strip foundations on foundation input motion is investigated. The free field motion is considered as vertical propagating SV waves with just translational movement at the surface. Various embedment depths and different proximity distances between foundations are studied. The simulation is done by ABAQUS software and the analysis is performed in three stages. First, the changes in time history of a sample record through a class of adjacency conditions were explored. Then, frequency domain aspects of proximity effect were investigated. In the third and final steps, spectral aspects of this phenomenon were examined for the same class of adjacency conditions. The results are presented in non-dimensional format. The main deduction is that for a surface foundation, adjacency to an embedded foundation causes rocking and vertical input motions. Meanwhile, the translational movement is adjusted too. This adjustment would intensify or diminish the free field translational motion in different frequency ranges.

Key Words: Kinematic interaction, strip foundation, adjacency, input motion.

INVESTIGATION OF MOISTURE AND PRELOADING EFFECTS ON FLEXURAL BEHAVIOR OF REINFORCED BEAMS WITH FRP

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EVALUATING THE INFLUENCE OF GRAIN SIZE ON SHEAR BAND THICKNESS UNDER PULLOUT CONDITIONS

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Abstract

The behavior of reinforced soil structures is largely governed by interaction mechanisms that develop between the reinforcement inclusions and fill material. Because of the variety of influential factors, the complex interaction mechanisms between soil and reinforcements are still far from clear. Different experimental methods, including direct shear and pullout tests, have been used to identify and improve the understanding of soil-reinforcement interaction. In the current research, pullout tests were used to evaluate soil-geogrid interaction through relative soil-reinforcement movements during pulling out of the reinforcement. In this regard, large-scale pullout tests (i.e., 100 x 60 x 60 cm) were carried out on samples reinforced with an HDPE geogrid, while digital images of deformed soil in close vicinity of the geogrid were captured and image processing was applied using particle image velocimetry (PIV) methods. Employing GeoPIV program, successive pairs of photographs were compared to determine the incremental values of displacements and strains at soil-reinforcement contact surfaces during pullout test. Samples were subjected to normal pressures of 25, 50 and 100 kPa. Two sandy and gravely soils of different particle sizes were used in the study for the preparation of samples to assess the influence of grain size on soil-geogrid interactions and the relative displacements. According to Unified Soil Classification System (USCS), sandy soils were classified as SP and SW and the gravely soil as GP. Results of the investigation showed that soil particles in close vicinity of transvers ribs are displaced in a circular manner, and the thickness of the shear band around the geogrid increases with the increase in grain size. Punching shear failure mechanism was found in SP soil, while general shear failure mode was observed in SW and GP soils during pulling out of the reinforcement. Also, with the increase in grain size, asymmetrical shapes of shear band change to symmetrical shapes.

Key Words: Pullout, geogrid, PIV, shear band, grain size.

DISCRETE ELEMENT METHOD MODELING OF BEHAVIOR OF A GRANULAR SOIL AND THE EFFECT OF UNSATURATED CONDITIONS ON SHEAR STRENGTH PARAMETERS

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Abstract

Soils consist of solid particles, pores, and pore fluids (air, water, other fluids), sometimes with interparticle bonding, to form a complex fabric. The behavior of natural soils is complex and difficult to model adequately by conventional non-linear elastic models or elasto-plastic ones. Micromechanics may prove helpful as an alternative method to overcome this complexity and physically describe its behavior. Micromechanics is used in this aim by two approaches.

The first is an experimental approach, which tries to understand the granular behavior by the laboratory experiments on sands, glass spheres and rods to observe the fabric changes, contact distribution, and shear bands.

The second approach uses Discrete Element Method (DEM) to numerically simulate the soil behavior. DEM considers a granular medium as an assemblage of particles interacting with each other in contact points. DEM is able to monitor the evolution of micro variables as force in contacts and their orientations. In DEM, the contact between the particles is detected and then contact force is calculated. These contact forces are used to calculate the displacements and rotations of each parti-

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Abstract

Traditional bridge design approaches are commonly based on sufficiently large safety margin to compensate the uncertainties of the design parameters and the unknowns of the related phenomena. This may lead to the conservative designs. Excessive local scour around bridge piers and abutments induced by hydraulic deficiencies is known as a major cause of the bridges failure. Complexity of the scouring phenomenon and high degree of uncertainties of the governing parameters lead to unavoidable risks in bridge pier and abutment designs. Thus, to obtain an appropriate level of security and reliability of the bridge structures, their risk of failure due to the scouring phenomenon needs to be evaluated.

In the present study, a generalized reliability model based on the static resistance-loading interference is developed for the assessment of reliability of the available formulas in the literature, to estimate local scour around the bridge abutments. By examining a comprehensive set of data, a two-parameter bivariate normal distribution is found to represent the joint probability density function of the resistance and loading. To obtain relevant information for the decision-making in design purposes, the model was applied to obtain a relationship between the reliability and safety factors. Thus, different probability distribution functions were tried on the effective dependent parameters, used in the derived equations of the former investigations. These parameters include channel width, abutment shape, sediment median size, and the flow discharge. To evaluate the reliability of each equation, Monte Carlo simulation method was applied and the reliability index of the considered equations was computed. Accordingly, among different available equations presented in the literature, the most reliable equation with the least probability of failure as well as the highest index of reliability was chosen as an appropriate equation to estimate the local scour around the bridge abutments. To obtain highly accurate results, the uncertainty of the dependent parameters on the scouring phenomenon at bridge abutment was examined. Among those, uncertainty of the flow depth and the flow velocity are the most significant factors in influencing the local scour around the bridge abutments.

Key Words: Bridge abutment, monte carlo simulation, risk analysis, scouring, uncertainty.

AN EXPERIMENTAL AND ANALYTICAL STUDY OF NEGATIVE HEAT TRANSFER IN LAKES

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Abstract

Negative heat flux is a special type of heat transfer that is generated by wind or ice on the water surface and takes place during the day in lakes. The negative heat flux produces horizontal and vertical density stratifications that can generate exchange flow between open water and covered areas. We conducted an investigation of the negative heat transfer generated in the laboratory by a surface cooling method. We examined the effective parameters of the heat flux in surface cooling. We used mixture of ice and water in a galvanized reservoir to model the cold source producing the negative heat flux. Over time, the negative heat flux through the bottom of galvanized reservoir was transferred to the water surface.

Temperature was measured by thermometer probes connected to a computer and was recorded continuously. The negative flux was then calculated from the temperature measurements at two close depths. We found that mass of ice and mass of water, distance between surface of water and the galvanized reservoir, and water area are the important parameters in the negative heat flux. We also developed an analytical model of the heat transfer in which the tank is assumed to be cooled from the surface and has adiabatic conditions at other boundaries. We used the magnitude of the negative heat flux from the experiment in the model and predicted the temperature at different times and depths. The results of experimental modeling and analytical solution are fairly in agreement. The reasons for the difference between the experimental results and the analytical solution are oscillation of the negative heat flux from the ice reservoir and the instability flow generated in the experiment tank below the ice reservoir. The instability appears in the form of instability fingers and plunges to the bottom of the tank due to a lower temperature of the cooled surface water relative to the tank temperature.

Key Words: Negative heat flux, wind cooling, surface cooling, experimental modeling, analytical solution.

tions. These errors in this study have been defined as the differences between the computed response from the proposed method in the nodal points and their corresponding exact responses within the domain and on the boundaries. Based on the concept of the cohesive crack, the crack initiation is modeled by controlling the existed applied vertical stresses on the crack faces. When these stresses reach a certain value, specifically in this study, the tensile strength of the concrete, the crack initiation is assumed to be occurred. After cracking, depending on the value of the opening crack displacement, (COD), applied stresses are enforced to reduce to zero for completely opened crack. For incorporating the discontinuity arising from the crack into the continuum shape function formulations of the proposed meshless method, the diffraction technique has been used.

Key Words: Crack, collocation discrete least squares meshless method, cohesive crack theory, diffraction method.

OPTIMAL DESIGN OF WATER DISTRIBUTION NETWORKS USING FUZZY ANALYTICAL HIERARCHY PROCESS

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Abstract

Water distribution networks are one of the main infrastructures of a country. Because of high costs of design and construction, minimizing the cost as a matter of scientific research is important. Minimizing the cost should be associated with achieving the required pressure at any point and reliability of the network. So, the integrated urban water management can be considered as a multi-objective problem. This research proposed a new method for the optimal design by comparing different algorithms to optimize water distribution networks as a multi-objective problem using Analytic Hierarchy Process (AHP) and Fuzzy Analytical Hierarchy Process (FAHP) in order to minimize the costs and maximize the three indicators of reliability index includes resiliency index (In), total surplus head index (It) and the minimum surplus head index (Im). These algorithms include genetic algorithm (GA), Honeybee mating optimization (HBMO), ant colony optimization (ACO), combinatorial optimization algorithm (AOC), Tabu search (TS), genetic algorithm linked with linear programming (GA-ILP), particle swarm optimization (PSO), state transition algorithm (STA), and mock open tree topology.

AHP is the multi attribute decision method, which uses pairwise comparisons with numerical judgments. When comparing two elements, the uncertain numerical ratio is expressed in a fuzzy manner rather than an exact one. Fuzzy AHP was introduced to capture the 'fuzziness' or the vagueness and uncertainty in the evaluation of alternatives. So the factor's weights were calculated using both AHP and FAHP methods.

To evaluate the performance and efficiency of the proposed model, Hanoi water distribution network was chosen as a case study. Results show that Genetic algorithm (ω= 10.9031) satisfies cost and the three indicators of reliability criteria with both compared methods of AHP and FAHP are better than other algorithms and the last ranks belong to algorithms in which at least one node with pressure is less than that with the minimum allowable pressure.

Key Words: Water distribution networks, optimization, fuzzy analytic hierarchy process, cost and reliability.

RELIABILITY ANALYSIS OF SCOURING AROUND THE BRIDGE ABUTMENTS

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Abstracts of Papers in English

CRACK GROWTH SIMULATION USING COLLOCATION DISCRETE LEAST SQUARES, COHESIVE CRACK, AND DIFFRACTION METHODS

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Abstract

During recent years, many researches have been conducted on the numerical methods for solving the governing differential equations. FEM is one of the strongest and most useful of these methods. However, this method encounters some difficulties when deals with the problems involving moving boundaries, crack propagation or extremely large deformation due to the need of renewing the mesh of the elements. One of the solutions is the elimination of the need for the mesh. Therefore, the meshfree methods have been developed. In the present study, Collocation Discrete Least Squares Meshless method (CDLSM) is formulated for predicting the crack growth phenomenon in the two-dimensional elastic solid problems. For simulating the crack initiation and growth, the cohesive crack concept has been implemented. CDLSM is a true meshless method which is developed based on the minimization of the sum of the squares of the errors in the nodal points in the domain and on the boundaries and does not use any kinds of background mesh for approximating the response function or for discretizing the developed system of equa-